Ultrabroad-band Raman light: Linear detuning & gain suppression

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Ultrabroad-band multifrequency Raman generation is a (laser-driven) resonant-symmetric two-colour pumping technique for exciting polychromatic light beams that are characterized by potentially very wide "top-hat" temporal bandwidths [1]. The spectra associated with such beams may have a width of the same order as the pump frequency, and contain scores of discrete Raman lines of comparable energy [2,3]. Here, we will report findings from the first systematic analysis addressing the interplay between finite material dispersion and detuning (where the frequency difference between the two pump waves no longer exactly matches the Raman transition). Of principal concern is how the dispersion-detuning feedback loop influences bandwidth generation. For simplicity, a continuous-wave model [4] is considered so that the input pulses driving the medium excitation are long compared to the characteristic dephasing time of the polarization wave (and transient dynamics are thus neglected). A host of new results will be unveiled (see Fig. 1), a particular highlight of which is the recent identification of a unique parameter regime wherein bandwidth growth may be strongly enhanced. Fully-numerical calculations are also compared against a generalized three-wave gain-suppression analysis [2] that can accommodate linear detuning.

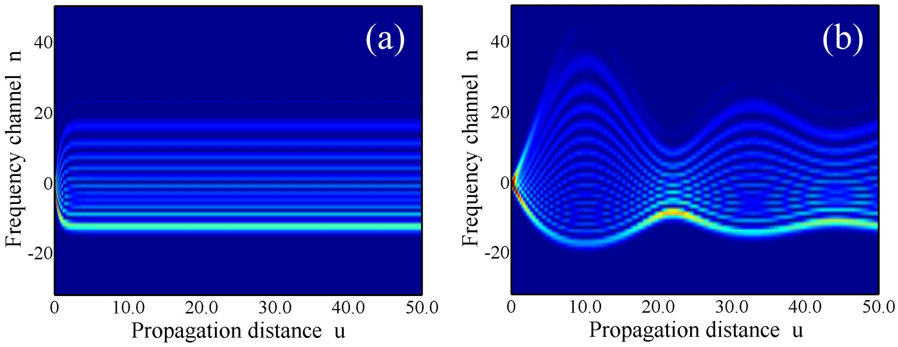

Figure 1. Simulation of continuous-wave ultrabroad-band multifrequency Raman light generation in the limit of zero background dispersion. (a) The zero-detuning solution of the model equations, and (b) finite level of detuning.

References

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